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Disease Mitigation Measures in the Control of Pandemic Influenza

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The threat of an influenza pandemic has alarmed countries around the globe and given rise to an intense interest in disease mitigation measures. This article reviews what is known about the effectiveness and practical feasibility of a range of actions that might be taken in attempts to lessen the number of cases and deaths resulting from an influenza pandemic. The article also discusses potential adverse second- and third-order effects of mitigation actions that decision makers must take into account. Finally, the article summarizes the authors' judgments of the likely effectiveness and likely adverse consequences of the range of disease mitigation measures and suggests priorities and practical actions to be taken.

THE THREAT OF AN INFLUENZA PANDEMIC, especially one caused by some variant of the highly pathogenic H5N1 avian strains, has alarmed countries around the world. There is universal agreement that the key to influenza prevention is vaccination, and both funds and research are now being expended in pursuit of an effective vaccine. However, producing a satisfactory vaccine will take at least 6 months after a new strain emerges that is demonstrably capable of causing a pandemic. Antiviral drugs offer hope of preventing some cases and possibly diminishing the severity of the disease if they are given within 24–48 hours after onset of symptoms. But supplies of these drugs are limited, the rapid development of virus resistance to the drugs is feared, and they are costly.

Accordingly, there has been interest in a range of disease mitigation measures. Possible measures that have been proposed include: isolation of sick people in hospital or at home, use of antiviral medications, hand-washing and respiratory etiquette, large-scale or home quarantine of people believed to have been exposed, travel restrictions, prohibition of social gatherings, school closures, maintaining personal distance, and the use of masks. Thus, we must ask whether any or all of the proposed measures are epidemiologically sound, logistically feasible, and politically viable. It is also critically important to consider possible secondary social and economic impacts of various mitigation measures.

Over the years, various combinations of these measures have been used under epidemic and pandemic circumstances in attempts to control the spread of influenza. However, there are few studies that shed light on the relative effectiveness of these measures. A historical review of communities in the U.S. during the 1918 influenza pandemic identified only two that escaped serious mortality and morbidity. Both communities had completely cut themselves off for months from the outside world. One was a remote town in the Colorado mountains, and the other was a naval training station on an island in San Francisco Bay.[1] Obviously, this is not a strategy of general utility. Other studies have suggested that, except in the most extreme applications, disease mitigation measures have not had a significant impact on altering the course of an influenza pandemic.[2,3]

A number of mitigation measures that are now being considered could have a serious impact on the ability of the health system to deliver adequate care and could have potentially adverse consequences for the provision of essential services. Many could result in significant disruption of

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the social functioning of communities and result in possibly serious economic problems. Such negative consequences might be worth chancing if there were compelling evidence or reason to believe they would seriously diminish the consequences or spread of a pandemic. However, few analyses have been produced that weigh the hoped-for efficacy of such measures against the potential impacts of large-scale or long-term implementation of these measures.

EPIDEMIOLOGIC EXPECTATIONS

Historically, it has been all but impossible to prevent influenza from being imported into a country or political jurisdiction, and there has been little evidence that any particular disease mitigation measure has significantly slowed the spread of flu. The clinical and epidemiologic characteristics of influenza explain why:

- The influenza virus is known to spread rapidly from one person to the next, with a second generation of patients occurring within 2–4 days following exposure.[4]
- People infected with influenza may shed virus for 1–2 days before becoming symptomatic.[5]
- Some flu-infected individuals may be asymptomatic and so would not be recognized as being infected. In seasonal flu outbreaks, this group may represent a significant proportion of infected people.[6,7] Asymptomatic individuals infected with flu have been shown to shed virus, although the extent to which these individuals transmit infection to others is not known.[8]
- Many patients who are symptomatic are not readily diagnosed because their symptoms differ little from individuals with other respiratory illnesses or allergies.

PANDEMIC PLANNING PREMISES

A new pandemic strain can be expected to spread rapidly and widely, but it is not likely to be constantly present in any given area. In both 1918 and 1957, there were some outbreaks in the U.S. of disease in the late spring, but the outbreaks were geographically limited. This has been referred to as the "first wave" of the pandemic. There were very few cases in the summer, but in the autumn a major pandemic wave of disease swept across the country during a 3–4-month period—the so-called "second wave." This was followed by a comparatively quiescent period, and then a "third wave" occurred the following spring. Subsequently, the new strain in each of these pandemics displaced the then-currently circulating strains and continued to recur every 2–3 years as seasonal flu, although it caused fewer serious illnesses.[9]

For planning purposes, the U.S. Department of Health and Human Services (HHS) and the White House Homeland Security Council (HSC) make the assumption that the expected attack rate in the next influenza pandemic would be comparable to the other 20th century pandemics—that is, about 25–30% of the population would become ill.[10,11] It is also assumed that the virus's ability to spread rapidly and widely would be comparable to past pandemics and that the duration of the outbreak in any given community would be about 8 weeks.[10,11] While government planners estimate that as much as 30% of the U.S. population would fall sick from the next pandemic, any given community would see those illnesses spaced over a period of at least 8 weeks, not all occurring at one time. Since the average duration of illness would be expected to be about 10 days, only a subset of flu victims in any community would be ill at once. Given this, even in the peak weeks of a pandemic it would seem reasonable to expect that no more than 10% of a community's population would be ill at any time.

The HHS and HSC documents assume that, in the worst case, the case-fatality ratio would be equal to that of 1918 (about 2.5%).[10,11] Such data as are available from the past 300 years show the 1918 influenza pandemic was, by far, the most lethal.

To date, the current H5N1 influenza case-fatality ratios have been 50% or more. H5N1 infection has been clinically more severe, and many patients have exhibited symptoms that differ from those caused by other influenza strains.[12,13] So far, the virus has exhibited little ability to spread from human to human. It has been widely assumed that if the current avian strain of virus did transform into one that is more readily transmissible, the virus would assume characteristics and case-fatality rates more closely resembling previous pandemic strains.

A range of possible measures for containing the spread of influenza during a pandemic are set forth in HHS's *Pandemic Influenza Plan*[10] and HSC's *National Strategy for Pandemic Influenza: Implementation Plan*.[11] Both documents outline possible actions that might be taken during a pandemic to minimize transmission and control the spread of infection. Disease mitigation measures are presented as a series of options, but the criteria for pursuing any particular measure are not articulated nor are operational details provided regarding how these measures should be implemented.

It has been recognized that most actions taken to counter pandemic influenza will have to be undertaken by local governments, given that the epidemic response capacity of the federal government is limited.[14] This is reflected in HHS Secretary Michael Leavitt's statement at a February 2006 State and Local Pandemic Preparedness Meeting: "Any community that fails to prepare [for an influenza pandemic] with the idea that somehow, in the end, the federal government will be able to rescue them will be tragically wrong."[15] But a recent review of the current pandemic in-

fluenza plans of 49 states reveals that few explicitly discuss implementing community mitigation strategies.[16] The authors of the review attribute this lack of planning for influenza in part to "weak central (federal) direction and the lack of key epidemiological data."[16] One of the better-developed plans is that of the New York City Department of Health and Mental Hygiene,[17] whose staff considered the use of disease mitigation measures but decided to incorporate few of the measures now described in federal plans.

A fundamental premise of disease mitigation that has been advanced by some in the policymaking community is that a less intense but more prolonged pandemic may be easier for society to bear,[18] but this is speculative.

CLARIFICATION OF TERMS

There is widespread confusion about the terms used to describe measures for controlling disease spread. The principal confusion is between use of the words *quarantine* and *isolation*. *Isolation* properly refers only to the confinement of *symptomatic* patients in the hospital (or at home) so that they will not infect others. *Quarantine* has traditionally been defined as the separation from circulation in the community of *asymptomatic* people who may have been exposed to infection and might—or might not—become ill. *Home quarantine* refers to voluntary confinement of known contacts of influenza cases in their own homes. *Large-scale quarantine* typically refers to confinement of large groups of possibly infected people—for example, all passengers on an airplane, or the residents of an apartment building or an entire city—for periods of days to weeks.

In recent years the term *social distancing* has come into use. *Social distancing* has been used to refer to a range of measures that might serve to reduce contact between people. These may include closing schools or prohibiting large gatherings, such as church services and sporting events. Others have used the term to refer to actions taken to increase the distance of individuals from each other at the work site or in other locations—for example, substituting phone calls for face-to-face meetings or avoiding hand-shaking. The term has come to describe fundamentally different approaches to disease mitigation. This document will refer only to specific interventions rather than to the catch-all term *social distancing*.

EVALUATION OF DISEASE MITIGATION MEASURES

Epidemiologic Assessment: Do available data or experience suggest the measure will work?

It is difficult to evaluate the effectiveness of specific measures to control disease spread in epidemiologic terms because of the complex interrelationships between individuals and groups and the individual biological differences in response to influenza. Some historical studies have tried to evaluate the efficacy of specific influenza containment efforts,[2] and, although they are informative, the relative paucity of such studies and the differences between past historical moments and the present limit the conclusions that can be drawn.

Recently, a number of mathematical models have examined various combinations of disease mitigation measures for pandemic influenza.[19–21] Such models consist of computer simulations of disease outbreaks that are developed from very limited data regarding the epidemiological and biological characteristics of influenza and a series of assumptions about the likely compliance of the population, the feasibility of applying various interventions, and so on. The predictions provided by such models can vary widely depending on the assumptions that are made in their construction.

What the computer models cannot incorporate is the effects that various mitigation strategies might have on the behavior of the population and the consequent course of the epidemic. There is simply too little experience to predict how a 21st century population would respond, for example, to the closure of all schools for periods of many weeks to months, or to the cancellation of all gatherings of more than 1,000 persons. Would these closures serve to decrease contacts between people and so retard the spread of the epidemic? Or would those affected spend more time in malls, in fast-food restaurants, and in other social settings that might result in more contacts and more rapid spread of influenza?

No model, no matter how accurate its epidemiologic assumptions, can illuminate or predict the secondary and tertiary effects of particular disease mitigation measures. Nor, for example, can it assess the potential effects of high absentee rates resulting from home or regional quarantine on the functioning integrity of essential services, such as hospital care or provision of food and electrical service to the community. If particular measures are applied for many weeks or months, the long-term or cumulative second- and third-order effects could be devastating socially and economically. In brief, models can play a contributory role in thinking through possible mitigation measures, but they cannot be more than an ancillary aid in deciding policy.

Logistical Assessment: Is the disease mitigation measure feasible?

Many communitywide disease mitigation measures would be intrinsically difficult to implement. Consideration must be given to the resources required for implementation, to the mechanisms needed to persuade the public to comply (or to compel the public, if the mea-

sures are mandatory), and to the length of time that they would need to be applied. Potential disease mitigation measures presumably would have to be maintained for the duration of the epidemic in a community—a predicted period of 8 or more weeks—or, perhaps, in the country as a whole—as long as 8 months.[18]

Recent experiences in endeavoring to quarantine large numbers of people during the 2003 SARS outbreaks illustrate why feasibility must be a central consideration. Canadian health officials implemented a voluntary home quarantine in Toronto, where an estimated 30,000 people who came in contact with SARS cases (fewer than 500 actual cases in all) were asked to stay home until it became clear that they were not infected.[22] Although the efficacy of the home quarantine in Toronto is not clear, the public health resources needed to implement this policy were prodigious, as it was necessary not only to persuade each family of the rationale of the measures and inform them how to comply but also to arrange to provide food and other support services. As a result of this and other experiences, medical authorities have expressed doubts about the efficacy and feasibility of large-scale and home quarantines.[14,23,24]

Social, Economic, and Political Assessment: What are the possible unintended adverse societal consequences?

Disease mitigation measures, however well intentioned, have potential social, economic, and political consequences that need to be fully considered by political leaders as well as health officials. Closing schools is an example. Some have suggested closure might be recommended for as long as a pandemic persists in a single community (perhaps 8 weeks) or for as long as a pandemic persists in the country (as long as 8 months).[18] The rationale for the strategy is to diminish contacts between students and so retard epidemic spread. However, if this strategy were to be successful, other sites where schoolchildren gather would also have to be closed: daycare centers, cinemas, churches, fast-food stores, malls, and athletic arenas. Many parents would need to stay home from work to care for children, which could result in high rates of absenteeism that could stress critical services, including health care. School closures also raise the question of whether certain segments of society would be forced to bear an unfair share of the disease control burden. A significant proportion of children in lower-income families rely on school feeding programs for basic nutrition.

Political leaders need to understand the likely benefits and the potential consequences of disease mitigation measures, including the possible loss of critical civic services and the possible loss of confidence in government to manage the crisis.

POTENTIAL DISEASE CONTROL MEASURES: BENEFITS AND CONSEQUENCES

Large-Scale Community Vaccination

Vaccines are the best mechanism for preventing influenza infection and spread in the community and for protecting healthcare workers caring for those who do become ill. Once an influenza strain capable of sustained human-to-human transmission emerges, a vaccine specific to the pandemic strain will need to be made. It is expected that it will be at least 6 months after the emergence of the pandemic strain before the *initial* supplies of vaccine can be produced. Current vaccine manufacturing techniques and limitations on vaccine production constrain the total amount of vaccine that can be manufactured. Special efforts are being made to increase this capacity,[25] but under current conditions, according to the *National Strategy for Pandemic Influenza*, it will be as much as 5 years (i.e., 2011) before domestic vaccine production capacity is in place to create enough vaccine for the entire U.S. population within 6 months of the start of a pandemic.[11]

Isolation of Sick People in Hospitals

Beyond widespread vaccination, isolating symptomatic influenza patients, either at home or in the hospital, is probably the most important measure that could be taken to reduce the transmission and slow the spread of illness within a community. The sickest (and presumably most contagious) patients are most likely to seek hospital care. The critical importance of hospitals in providing health care during a pandemic cannot be overstated and has been addressed by a number of sources.[26–30]

In an influenza epidemic, hospitals will face several key challenges. First, hospitals must protect their own staffs from infection and avoid becoming "amplifiers" of disease. Historically, hospitals have often accelerated the spread of contagious disease because of the presence of highly contagious patients and their close proximity to the medical staff who care for them and to other patients who are ill and vulnerable to infection.[31] Modern hospitals are not designed to accommodate large numbers of highly contagious patients, and special measures, including cohorting of patients, adjustments to HVAC systems, and use of personal protective gear, will need to be made to protect healthcare workers and patients from infection.

Second, hospitals must establish strategies for coping with what will presumably be a large and relatively sustained surge in demand for medical care. At present, hospitals have little capacity to meet such demands.[27,30,32] Hospital care will be needed not only for those who are ill with influenza itself but also for patients with chronic

conditions made critical by acute influenza infection. Accommodating the increased demand for hospital care will require coordination and collaboration between hospitals in a given region and among hospital leaders, public health authorities, and elected officials. Some jurisdictions have taken steps to establish the organizational framework, communication networks, and operational principles needed to do this,[29] but most have not. It is noteworthy that, in spite of the predominant role that hospitals must play in pandemic response, the federal allocations for pandemic flu preparedness have included little financial support either for regional medical care planning or for the hospitals themselves.[33]

In 1918–19, even the best-equipped hospitals had little to offer flu victims. Today, however, although modern medicine offers limited remedies for influenza, the availability of oxygen, ventilators, antibiotics, and parenteral fluids could make a critical difference in surviving flu, especially among those with underlying chronic disease.

It has been suggested that alternative care sites, such as gymnasiums and armories, could lessen the demand on hospitals.[10,34] In 1918, such alternative care facilities were set up in many cities. However, patients housed in alternative sites received little more than food and water. Such sites realistically would represent alternatives to home care, not hospital care, given the practical problems of safely managing services such as respiratory support, intravenous medication, oxygen, and the like outside of a hospital setting. A major challenge for all authorities charged with managing a pandemic will be how to allot scarce, possibly life-saving medical resources and how to maintain hospitals' capacity to care for critically ill flu victims while continuing to provide other essential medical services.

Home Isolation of Sick People

In light of the expected shortages of medical beds and personnel, home isolation of non–critically ill influenza patients would be necessary in a major pandemic. A policy that persuades sick individuals to voluntarily stay at home unless they are critically ill would allow hospitals to focus efforts on those most seriously threatened.

There are a number of logistical considerations that could prevent people from being able to remain isolated in their homes. Special measures would be needed to provide basic medical and food supplies, perhaps through the use of neighborhood volunteers and supplemented by communication by phone or internet. It may not be easy to persuade those without paid sick leave (some 59 million persons[35]) to absent themselves from work, unless employers address this problem directly. A recent review of state pandemic influenza plans found that only one-third of the 49 states examined have explicit plans to encourage voluntary home isolation.[16]

Use of Antiviral Medications

Antiviral drugs for influenza are available in limited quantities. Data on how antivirals might perform in the prevention or treatment of the H5N1 strain are scant. Prominent authorities think the likelihood of "quenching" an emergent pandemic strain through the rapid, regionwide use of antivirals is low because of technical and logistical difficulties, even if the pandemic strain proves to be sensitive to such drugs.[36] Several countries have recommended that the top priority for antivirals is to treat the ill.[37,38] If antivirals were to be used for prevention, it would imply the need for much longer administration of the drug to cover the period of a community epidemic. Specifically, using oseltamivir as the most available example, the quantity of antivirals used to *prevent* infection in a single healthcare worker during an 8–10-week epidemic period would serve to *treat* an estimated 5 to 7 patients (assumes prophylaxis with 75 mg, twice daily, for 8–10 weeks versus treatment with 150 mg, twice daily, for 5 days).[39]

Moreover, available data indicate that antiviral treatment is effective only if antivirals are given within 24–48 hours after onset of initial symptoms.[40] Some authorities doubt the feasibility of administering the drugs soon enough to make a difference during a pandemic.[16,32,41] Because of this concern, at least one Canadian teaching hospital is planning to use all its antiviral stocks for prophylaxis of healthcare workers.[42] The European Union, on the other hand, decided not to stockpile any antiviral medicines, although some European countries have done so.[43]

The effectiveness and optimal use of antivirals remain uncertain because of several factors: the propensity of the influenza virus to mutate, thus increasing the possibility that resistance could develop; the quantities of antivirals required for prophylaxis; and the logistical challenges involved in providing sufficiently rapid treatment. Contextual variables that cannot be predicted ahead of time—such as the quantity of medicines available and the development of resistance—will probably determine antiviral strategy.

Hand-Washing and Respiratory Etiquette

The influenza virus actually survives on the hands for less than 5 minutes,[4] but regular hand-washing is a commonsense action that should be widely followed. It has been shown to reduce the transmission of respiratory illness in a military trainee setting,[44] although there are no data to demonstrate that hand-washing deters the spread of influenza within a community.

General respiratory hygiene, such as covering one's mouth when coughing and using disposable paper tissues, is widely believed to be of some value in diminishing spread, even though there is no hard evidence that this is so.

Large-Scale Quarantine Measures

There are no historical observations or scientific studies that support the confinement by quarantine of groups of possibly infected people for extended periods in order to slow the spread of influenza. A World Health Organization (WHO) Writing Group, after reviewing the literature and considering contemporary international experience, concluded that "forced isolation and quarantine are ineffective and impractical."[2] Despite this recommendation by experts, mandatory large-scale quarantine continues to be considered as an option by some authorities and government officials.[35,43]

The interest in quarantine reflects the views and conditions prevalent more than 50 years ago, when much less was known about the epidemiology of infectious diseases and when there was far less international and domestic travel in a less densely populated world. It is difficult to identify circumstances in the past half-century when large-scale quarantine has been effectively used in the control of any disease. The negative consequences of large-scale quarantine are so extreme (forced confinement of sick people with the well; complete restriction of movement of large populations; difficulty in getting critical supplies, medicines, and food to people inside the quarantine zone) that this mitigation measure should be eliminated from serious consideration.

Home Quarantine

Voluntary home quarantine would be requested of individuals who are asymptomatic but who have had substantial contact with a person who has influenza—primarily household members. The aim of voluntary home quarantine is to keep possibly contagious, but still asymptomatic, people out of circulation. This sounds logical, but this measure raises significant practical and ethical issues.

If implemented on a communitywide scale, logistical requirements related to ensuring that quarantined households across a community had appropriate care and support would be necessary. How compliant the public might be is uncertain. Parents would presumably be willing to stay home and care for sick children, but it is not known, for example, whether college students would agree to be interned with infected dorm-mates.

Even if home quarantine were generally acceptable to the community, individuals may not have the economic resources to stay at home. Few employers currently have provisions for paid absence unless the workers themselves are ill. For those who are hourly workers or who are self-employed, the potential loss of wages as a result of having to stay home simply because an individual had had contact with sick people might not be acceptable or feasible.

Home quarantine also raises ethical questions. Implementation of home quarantine could result in healthy, uninfected people being placed at risk of infection from sick household members. Practices to reduce the chance of transmission (hand-washing, maintaining a distance of 3 feet from infected people, etc.) could be recommended, but a policy imposing home quarantine would preclude, for example, sending healthy children to stay with relatives when a family member becomes ill. Such a policy would also be particularly hard on and dangerous to people living in close quarters, where the risk of infection would be heightened.

Travel Restrictions

Travel restrictions, such as closing airports and screening travelers at borders, have historically been ineffective. The World Health Organization Writing Group concluded that "screening and quarantining entering travelers at international borders did not substantially delay virus introduction in past pandemics . . . and will likely be even less effective in the modern era."[2]

Similar conclusions were reached by public health authorities involved in the international efforts to control SARS. Canadian health authorities report that "available screening measures for SARS were limited in their effectiveness in detecting SARS among inbound or outbound passengers from SARS-affected areas."[45] A review by a WHO Working Group on SARS also concluded that "entry screening of travelers through health declarations or thermal scanning at international borders had little documented effect on detecting SARS cases."[46]

The authors have concluded in a previous analysis[47] that screening individuals on domestic interstate flights for symptoms of flu, as has been proposed in revisions to the Federal Quarantine Rule (42 CFR Parts 70 and 71),[48] would not be effective and would have serious adverse consequences.

It is reasonable to assume that the economic costs of shutting down air or train travel would be very high, and the societal costs involved in interrupting all air or train travel would be extreme. Shutting down public transportation for an extended period is not an option in many cities. In New York City, an average of 4.7 million people ride the subway each weekday;[49] the Los Angeles Metro averages 1.3 million riders daily.[50]

Prohibition of Social Gatherings

During seasonal influenza epidemics, public events with an expected large attendance have sometimes been

cancelled or postponed, the rationale being to decrease the number of contacts with those who might be contagious. There are, however, no certain indications that these actions have had any definitive effect on the severity or duration of an epidemic. Were consideration to be given to doing this on a more extensive scale and for an extended period, questions immediately arise as to how many such events would be affected. There are many social gatherings that involve close contacts among people, and this prohibition might include church services, athletic events, perhaps all meetings of more than 100 people. It might mean closing theaters, restaurants, malls, large stores, and bars. Implementing such measures would have seriously disruptive consequences for a community if extended through the 8-week period of an epidemic in a municipal area, let alone if it were to be extended through the nation's experience with a pandemic (perhaps 8 months).[22] In the event of a pandemic, attendance at public events or social gatherings could well decrease because people were fearful of becoming infected, and some events might be cancelled because of local concerns. But a policy calling for communitywide cancellation of public events seems inadvisable.

School Closures

In previous influenza epidemics, the impact of school closings on illness rates has been mixed.[2] A study from Israel reported a decrease in respiratory infections after a 2-week teacher strike, but the decrease was only evident for a single day.[51] On the other hand, when schools closed for a winter holiday during the 1918 pandemic in Chicago, "more influenza cases developed among pupils . . . than when schools were in session."[2,52]

Schools are often closed for 1–2 weeks early in the development of seasonal community outbreaks of influenza primarily because of high absentee rates, especially in elementary schools, and because of illness among teachers. This would seem reasonable on practical grounds. However, to close schools for longer periods is not only impracticable but carries the possibility of a serious adverse outcome. For example, for working parents, school serves as a form of day care and, in some areas, a source of nutritional meals for children from lower-income families. In 2005, some 29.5 million children were fed through the National School Lunch Program; 9.3 million children received meals as part of the School Breakfast Program.[53] A portion of America's workforce would be unable to go to work as long as children were out of schools. Heightened absentee rates could cripple essential service industries. Teachers might not be paid and a great many hourly workers (mall and fast-food employees; school janitorial, security, and kitchen staff; bus drivers) would face particular financial hardship.

Maintaining Personal Distance

It has been recommended that individuals maintain a distance of 3 feet or more during a pandemic so as to diminish the number of contacts with people who may be infected.[10,54] The efficacy of this measure is unknown. It is typically assumed that transmission of droplet-spread diseases, such as influenza, is limited to "close contacts"—that is, being within 3–6 feet of an infected person.[4] Keeping a space of 3 feet between individuals might be possible in some work environments, but it is difficult to imagine how bus, rail, or air travelers could stay 3 feet apart from each other throughout an epidemic. And such a recommendation would greatly complicate normal daily tasks like grocery shopping, banking, and the like.

Use of Masks and Personal Protective Equipment

Masks and other personal protective equipment (PPE) are essential for controlling transmission of influenza in hospitals. For people who work in hospitals, current CDC guidelines for influenza infection control recommend droplet precautions, including the use of surgical masks. But HHS planning guidelines also rightly acknowledge that the uncertainties regarding the potential of virus transmission at the start of a new pandemic would recommend that airborne precautions be used in hospitals—that is, N95 masks (already in short supply)[7] or powered air purifying respirators (PAPRs).[10] Patients would be advised to wear surgical masks to diminish the number of infectious respiratory particles being dispersed into the air, thereby diminishing the likelihood of further spread.[55]

In Asia during the SARS period, many people in the affected communities wore surgical masks when in public. But studies have shown that the ordinary surgical mask does little to prevent inhalation of small droplets bearing influenza virus.[56] The pores in the mask become blocked by moisture from breathing, and the air stream simply diverts around the mask. There are few data available to support the efficacy of N95 or surgical masks outside a healthcare setting. N95 masks need to be fit-tested to be efficacious and are uncomfortable to wear for more than an hour or two.[55,57] More important, the supplies of such masks are too limited to even ensure that hospitals will have necessary reserves.[58]

COMMUNITY RESPONSE TO A PANDEMIC: A SUMMARY OF POSSIBLE ACTIONS

There is no question but that another influenza pandemic will occur and that every community needs to be

prepared for that eventuality. Influenza is unlike any other disease epidemic in the rapidity with which it spreads and, as it emerges, the number of illnesses that it can cause over a period of a few months. It is unpredictable as to when a pandemic might begin. It could be next autumn or it may not be for a number of years. The world has weathered three pandemics during the past century and will certainly surmount the next one. How much damage the pandemic will cause depends to a large extent on the state of readiness of each community and each metropolitan region and the efficacy and reasonableness of its response. The following is a synopsis of the authors' judgments regarding possible disease mitigation measures.

Vaccination. Vaccination is, by far, the most important preventive measure, but pandemic strain vaccine will not be available for at least the next season. Meanwhile, communitywide use of the seasonal influenza vaccine is desirable, as it is likely that outbreaks of seasonal flu will occur even if there is pandemic influenza.

Provision for isolation and medical care of influenza patients. A Regional Health Care Operations Committee[27] is a priority need to assure collaboration and cooperation across the community (hospitals, medical care providers, Red Cross, law enforcement, media, and others), both for advanced planning and during the epidemic to assure that the large numbers of flu-infected patients can be cared for in hospital, at home, or in special facilities. Special arrangements are needed for expanding surge capacity in hospitals, for support to permit home care of patients, and for the provision of additional volunteer healthcare staff.

A communication strategy and plans. Open and frequent communications with the public are essential. This involves regular press conferences, hot lines, and provision of information through civic leaders, churches, schools, and businesses. An important message is to request that all who are ill remain isolated at home or in the hospital but to encourage others to continue to come to work so that essential services can be sustained.

Closure of schools. It has been the practice in many communities to close the schools for 10–14 days at the beginning of an epidemic of seasonal flu, primarily because of the number of both teachers and pupils who are absent. This is a reasonable initiative, often expected in many communities, that also serves to demonstrate action on the part of officials. Closing schools for longer periods in hopes of mitigating the epidemic by decreasing contacts among students is not warranted unless all other likely points of assembly are closed (e.g., malls, fast-food restaurants, churches, recreation centers, etc.). Such widespread closures, sustained throughout the pandemic, would almost certainly have serious adverse social and economic effects.

Hand-washing and respiratory hygiene. Everyone should be encouraged to wash their hands after coming in contact with people who are ill and to cover their mouths when coughing or sneezing.

Cancelling or postponing meetings or events involving large numbers of people. Intuitively, this would appear to be a helpful adjunct to reduce contacts among people and so mitigate the effects of the epidemic. However, individuals normally have a great many contacts throughout the community on a daily basis: shopping in stores, attending church, traveling on public transport, and so on. Recognizing that the spread of influenza is primarily by person-to-person contact, any one individual, even in a large gathering, would have only a limited number of such close encounters with infected people. Thus, cancelling or postponing large meetings would not be likely to have any significant effect on the development of the epidemic. While local concerns may result in the closure of particular events for logical reasons, a policy directing communitywide closure of public events seems inadvisable.

Quarantine. As experience shows, there is no basis for recommending quarantine either of groups or individuals. The problems in implementing such measures are formidable, and secondary effects of absenteeism and community disruption as well as possible adverse consequences, such as loss of public trust in government and stigmatization of quarantined people and groups, are likely to be considerable.

Screening passengers at borders or closing air or rail hubs. Experience has shown that these actions are not effective and could have serious adverse consequences; thus, they are not recommended.

An overriding principle. Experience has shown that communities faced with epidemics or other adverse events respond best and with the least anxiety when the normal social functioning of the community is least disrupted. Strong political and public health leadership to provide reassurance and to ensure that needed medical care services are provided are critical elements. If either is seen to be less than optimal, a manageable epidemic could move toward catastrophe.

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